

# High-Mu Triode

## ENVIRONMENTAL TESTS

## NUVISTOR TYPE

## LIFE TESTS

*For Condenser-Microphone Preamplifiers, Piezoelectric- and Ceramic-Pickup Preamplifiers, and Other Voltage Amplifier Applications Requiring Amplification of Extremely Small Signals at DC to 200 kc/s*

## ELECTRICAL CHARACTERISTICS

## Bogey Values

Heater Voltage, (DC or AC) . . . . .	$E_f$	6.3	V
Heater Current at $E_f = 6.3$ V . . . . .	$I_f$	100	mA
Heater Input . . . . .	$P_f$	0.63	W
<b>Direct Interelectrode Capacitances</b>			
Without external shield			
Input: G to (K, S, H) . . . . .	$C_i$	3.4	pF
Output: P to (K, S, H) . . . . .	$C_o$	1.7	pF
Plate to cathode . . . . .	$C_{pk}$	0.20	pF
Grid to cathode . . . . .	$C_{gk}$	2.6	pF
Heater to cathode . . . . .	$C_{hk}$	1.0	pF

CLASS A<sub>1</sub> AMPLIFIER

*For Following Characteristics see Conditions*

Amplification Factor . . . . .	$\mu$	127	
Plate Resistance (Approx.) . . . . .	$r_p$	41	k $\Omega$
Transconductance . . . . .	$g_m$	3100	$\mu$ mho
DC Plate Current . . . . .	$I_b$	1.5	mA
Cutoff DC Grid Voltage for $I_b = 10$ $\mu$ A. . . . .	$E_{c(co)}$	-1.7	V

## Conditions

Heater Voltage . . . . .	$E_f$	6.3	V
Plate Supply Voltage . . . . .	$E_{bb}$	120	V
Grid Supply Voltage . . . . .	$E_{cc}$	0	V
Cathode Resistor . . . . .	$R_k$	200	$\Omega$
Metal Shell . . . . .	Connected to system ground		

## ABSOLUTE MAXIMUM RATINGS

*For operation as a Class-A<sub>1</sub> Amplifier Tube at frequencies up to 200 kc/s*

Plate Supply Voltage . . . . .	E <sub>bb</sub>	330	V
DC Plate Voltage . . . . .	E <sub>b</sub>	250	V
Grid Voltage			
Peak positive value. . . . .	e <sub>cm</sub>	0	V
DC positive value. . . . .	E <sub>c</sub>	0	V
DC negative value. . . . .	E <sub>c</sub>	-55	V
Peak Heater-Cathode Voltage. . . . .	e <sub>hkm</sub>	±100	V
Heater Voltage, DC or AC . . . . .	E <sub>f</sub>	5.7 to 6.9	V
Instantaneous Voltage. . . . .	See Breakdown-Voltage Characteristics Curve		
Between base pins and metal shell			
Average Cathode Current. . . . .	I <sub>k(av)</sub>	2	mA
Plate Dissipation. . . . .	P <sub>b</sub>	0.3	W
Envelope Temperature <sup>c</sup> . . . . .	T <sub>E</sub>	150	°C



## MAXIMUM CIRCUIT VALUES

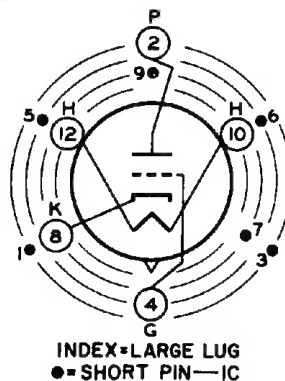
## Grid-Circuit Resistance

For fixed-bias operation . . . . .	$R_g(\text{ckt})$	50	M $\Omega$
For cathode-bias operation . . . . .	$R_g(\text{ckt})$	100	M $\Omega$

## MECHANICAL CHARACTERISTICS

Operating Position . . . . .	Any
Type of Cathode. . . . .	Coated Unipotential
Maximum Overall Length ( $l_m$ ) . . . . .	0.800 in
Maximum Seated Length ( $l_{sm}$ ) . . . . .	0.625 in
Maximum Diameter ( $d_m$ ) . . . . .	0.440 in
Weight (Approx.) . . . . .	1.9 g
Dimensional Outline . . . . .	JEDEC No. 4-4
Envelope . . . . .	JEDEC Designation MT4
Base <sup>a</sup> . . . . .	Medium-Ceramic-Wafer Twelvvar 5-Pin (JEDEC E5-65)
Basing Designation for BOTTOM VIEW . . . . .	12AQ

Pin 1 <sup>b</sup> - Do Not Use
Pin 2 - Plate
Pin 3 <sup>b</sup> - Do Not Use
Pin 4 - Grid
Pin 5 <sup>b</sup> - Do Not Use
Pin 6 <sup>b</sup> - Do Not Use
Pin 7 <sup>b</sup> - Do Not Use
Pin 8 - Cathode
Pin 9 <sup>b</sup> - Do Not Use
Pin 10 - Heater
Pin 11 - Omitted
Pin 12 - Heater



## TYPICAL OPERATION

In High-Input-Impedance, Cathode-Follower Circuit

Heater Voltage . . . . .	$E_f$	6.3	V
Plate Supply Voltage . . . . .	$E_{bb}$	150	V
Cathode Bias Resistor (Bypassed) . . .	$R_k(\text{bias})$	3.3	k $\Omega$
Cathode Load Resistor . . . . .	$R_k(\text{load})$	15	k $\Omega$
Grid Resistor . . . . .	$R_g$	100	M $\Omega$
Input Resistance (Approx.) . . . . .	$R_i$	1	G $\Omega$
Output Resistance (Approx.) . . . . .			
Source resistance ( $R_s$ ) = 1 G $\Omega$ . . . . .	$R_o$	7	k $\Omega$
Average Grid Current . . . . .	$I_c(\text{av})$	-0.1	nA
Average Plate Current . . . . .	$I_b(\text{av})$	0.3	mA

<sup>a</sup> Designed to mate with Cinch Mfg. Co. Socket No. 133 65 92 025, 133 65 91 034, or equivalent.

<sup>b</sup> Pins 1, 3, 5, 6, 7, and 9 are of a length such that their ends do not touch the socket insertion plane.

<sup>c</sup> Measured on metal shell in Zone "A" (See Dimensional Outline).



## INITIAL CHARACTERISTICS LIMITS

	Note	Min	Max	
Heater Current . . . . .	1	90	110	mA
Direct Interelectrode Capacitances				
Grid to plate. . . . .	2	-	0.7	pF
Input: G to (K, S, H). . . . .	2	3.0	3.8	pF
Output: P to (K, S, H) . . . . .	2	1.5	1.9	pF
Plate to cathode . . . . .	2	0.17	0.23	pF
Grid to cathode. . . . .	2	2.2	3.0	pF
Heater to cathode. . . . .	2	0.8	1.2	pF
Amplification Factor . . . . .	3	95	160	
Transconductance . . . . .	3	2200	4000	$\mu$ mho
Plate Current. . . . .	3	0.7	2.3	mA
Cutoff Plate Current . . . . .	4	-	200	$\mu$ A
AC Voltage Amplification . . . . .	5	7	-	V
Total Grid Current . . . . .	6	-	-0.05	$\mu$ A
Heater-Cathode Leakage Current . . .	7	-	$\pm 5$	$\mu$ A
Leakage Resistance				
Between grid and all other electrodes connected together . .	8	50	-	G $\Omega$
Between plate and all other electrodes connected together . .	9	100	-	G $\Omega$
Inoperatives . . . . .	10		✓	

Note 1: With  $E_f = 6.3$  V.

Note 2: Measured without external shield.

Note 3: With  $E_f = 6.3$  V,  $E_{bb} = 120$  V,  $E_{cc} = 0$  V,  $R_k = 200 \Omega$ ,  $C_k = 1000 \mu F$ , metal shell grounded.

Note 4: With  $E_f = 6.3$  V,  $E_b = 120$  V,  $E_c = -1.7$  V, metal shell grounded.

Note 5: With  $E_f = 6.3$  V,  $E_{bb} = 120$  V,  $E_{cc} = 0$  V,  $R_g = 10 M\Omega$ ,  $C_{c(in)} = 0.1 \mu F$ , grid-signal-source internal impedance  $< 2500 \Omega$ ,  $E_g = 0.2$  V (rms, 60 c/s, sinewave),  $R_p = 0.5 M\Omega$ ,  $C_{c(out)} = 0.5 \mu F$ . RMS voltage component measured across the series plate resistor with a  $5 M\Omega$  (min.) input impedance vacuum-tube voltmeter.

Note 6: With  $E_f = 6.3$  V,  $E_b = 200$  V,  $E_{cc} = -1$  V,  $R_g = 1 M\Omega$ , metal shell grounded.

Note 7: With  $E_f = 6.3$  V,  $E_{hk} = \pm 100$  V.

Note 8: With  $E_f = 6.3$  V,  $E_{g-all} = -100$  V, metal shell grounded.

Note 9: With  $E_f = 6.3$  V,  $E_{p-all} = -300$  V, metal shell grounded.

Note 10: Tubes are criticized for Shorts, Discontinuities, and Air Leaks.

## ENVIRONMENTAL TESTS

## High-Impact, Short-Duration Shock

Peak Impact Acceleration . . . . . 1000 g

Duration of Approximate Half-Sine-Wave

Mechanical-Shock Pulse . . . . .  $0.8 \pm 0.2$  ms

Operating Conditions during Test

$E_f = 6.3$  V,  $E_{bb} = 120$  V,  $E_{cc} = 0$  V,  $R_k = 200 \Omega$ ,  $R_g = 1 M\Omega$ ,  $E_{hk} = 100$  V.



	Min	Max	
<b>Post-Shock Limits and Rejection Criteria</b>			
$E_{Rp}$ (AC Voltage Amplification) . . . . .	6	-	V
$I_c$ . . . . .	-	-0.1	$\mu A$
$I_{hk}$ . . . . .	-	$\pm 10$	$\mu A$
$E_{Rpm}$ (Variable-Frequency-Vibration Test Limits) over Vibration-Frequency Range of:			
3 to 6 kc/s . . . . .	-	50	mV
6 to 15 kc/s . . . . .	-	1000	mV
<b>Tap and Permanent Shorts, and Discontinuities.</b> . . . .		✓	

**Low-Impact, Long-Duration Shock**

<b>Peak Impact Acceleration</b> . . . . .	50	g
<b>Duration of Approximate Half-Sine-Wave</b>		
<b>Mechanical-Shock Pulse</b> . . . . .	$11 \pm 2$	ms
<b>Condition during Test</b>		

No tube-element voltages are applied.

**Post-Shock Limits and Rejection Criteria**

Same as those specified above for the High-Impact, Short-Duration Shock Test.

**Sweep-Frequency-Vibration Fatigue**

<b>Vibration-Frequency Range (Overall)</b> . . . . .	5 to 500 to 5	c/s
<b>Peak Displacement</b>		
5 to 50 & 50 to 5 c/s . . . . .	0.040	in
Peak-to-peak value . . . . .	0.080	in
<b>Peak Vibrational Acceleration.</b> . . . . .	10	g
50 to 500 to 50 c/s		
<b>Period of 1 Sweep Cycle (Approx.)</b> . . . . .	15	m
5 to 500 to 5 c/s		
<b>Duration of Test (Overall)</b> . . . . .	9	h
Along each of 3 mutually perpendicular axes.	3	h
<b>Operating Condition during Test</b>		

 $E_f = 6.3$  V**Post-Sweep-Frequency-Vibration-Fatigue Limits and Rejection Criteria**

Same as those specified above for the High-Impact-Short-Duration Shock Test.

**Variable-Frequency Vibration**

<b>Vibration-Frequency Range (Overall)</b> . . . . .	3 to 15	kc/s
<b>Peak Vibrational Acceleration.</b> . . . . .	1	g
In $X_1$ position		
<b>Period of 1 Sweep Cycle (3 to 15 kc/s)</b> . . . . .	7	s
<b>Operating Conditions during Test</b>		

 $E_f = 6.3$  V,  $E_{bb} = 120$  V,  $E_{cc} = 0$  V,  $R_k = 200 \Omega$ ,  $R_p = 2$  k $\Omega$ .

Limits	Min	Max	
$E_{Rpm}$ over Vibration-Frequency Range of:			
3 to 6 kc/s. . . . .	-	35	mV
6 to 15 kc/s. . . . .	-	700	mV



## LIFE TESTS

## Heater Cycling

Duration of Test . . . . . 2000 cycles

## Operating Conditions

 $E_f = 8.5$  V cycled 1 minute ON and 2 minutes OFF,  $E_{hk} = -180$  V continuously ON.

## Rejection Criteria

Heater-Cathode Shorts, and Heater and Cathode Discontinuities.

## Intermittent Operation (2, 20, 100, 500, and 1000 Hours)

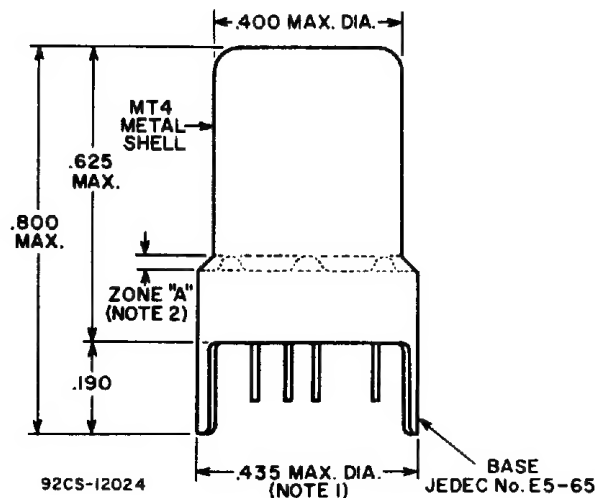
## Operating Conditions

 $E_f = 6.3$  V cycled 110 minutes ON and 10 minutes OFF,  $E_b = 120$  V,  $E_{cc} = -1$  V,  $E_{hk} = 100$  V,  $R_k = 0 \Omega$ ,  $R_g = 1 M\Omega$ ,  $P_b = 0.3$  W (approx.),  $T_E = 150^\circ\text{C}$  min.

End-Point Limits At	2 and 20		100		500		1000		h
	Min	Max	Min	Max	Min	Max	Min	Max	
$g_m$ . . . . .	-	-	2000	-	-	-	-	-	$\mu\text{mho}$
$\Delta g_m/t$ . . . . .	-	$\pm 10$	-	-	-	-	-	-	%
$\Delta E_{rp}/t$ . . . . .	-	-	-	-	-	$\pm 10$	-	$\pm 15$	%
Avg $ \Delta E_{rp}/t $ . . . . .	-	-	-	-	-	7	-	10	%
$I_c$ . . . . .	-	-	-	-0.05	-	-0.1	-	-0.1	$\mu\text{A}$
$I_{hk}$ . . . . .	-	-	-	-	-	$\pm 10$	-	$\pm 10$	$\mu\text{A}$

## DIMENSIONAL OUTLINE

JEDEC No. 4-4



## DIMENSIONS IN INCHES

Note 1: Maximum outside diameter of 0.440" is permitted along 0.190" lug length.

Note 2: Envelope temperature should be measured in zone "A".



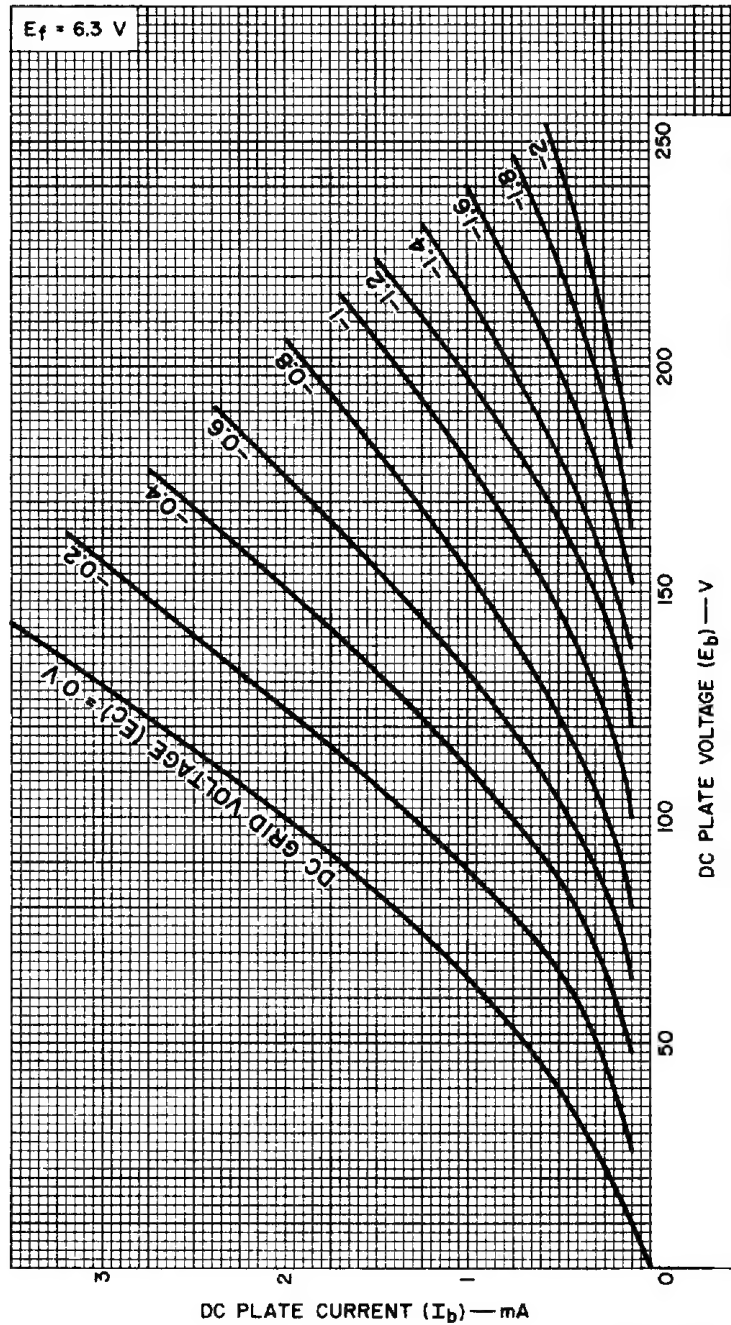
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# Typical Plate Characteristics



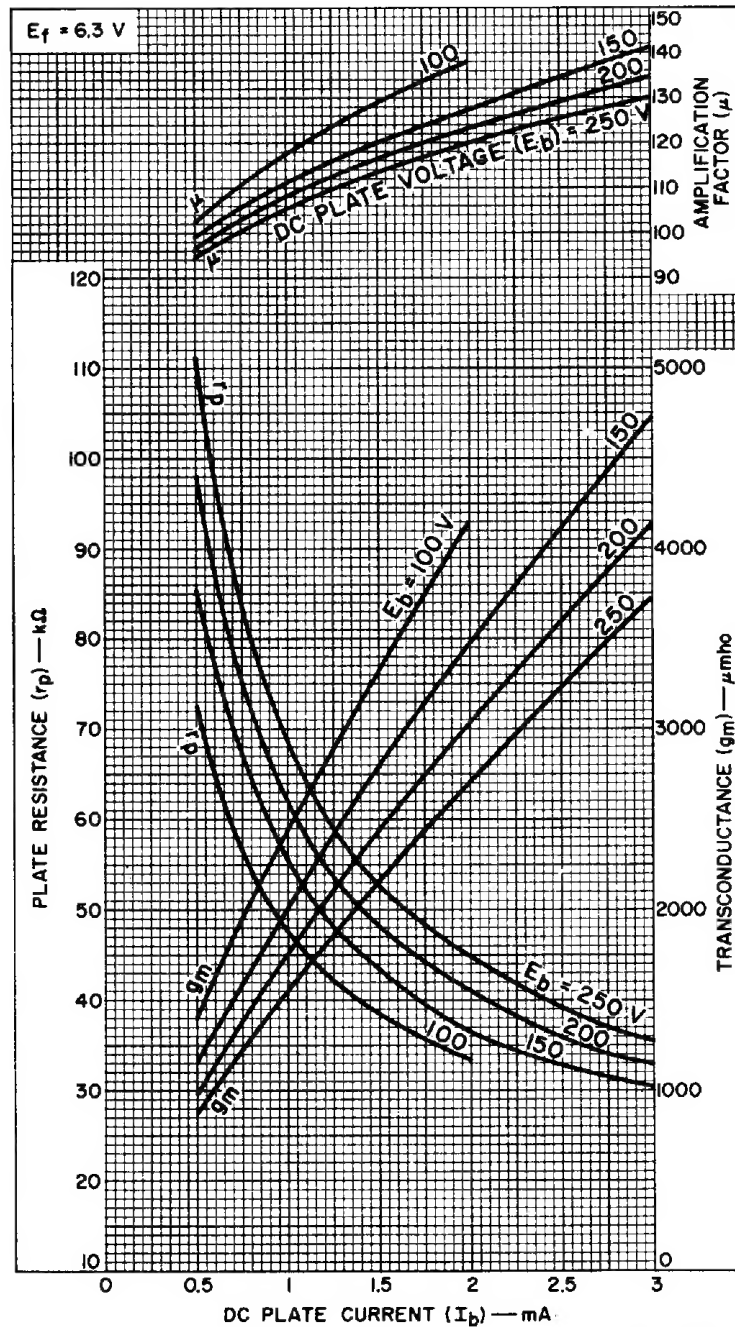
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DATA 3

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## Typical Characteristics



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## Breakdown-Voltage Characteristic

